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STUDY TASK NUMBER 3. ANALYSIS OF SUBRAP PROGRAM UTILITY,(U)
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STUDY TASK NO. 3, ANALYSIS OF SUBRAP PROGRAM UTILITY,

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ABSTRACT

The existing SUBRAP (Submarine RAnge Prediction) program does not effectively provide the submarine force with useful timely acoustic range prediction data. The primary limitations are: (1) the extensive communications time required to pass the data, and (2) the inability to apply acoustic measurements taken in-situ by the submarine to the predicted data.

This report proposes that a method similar to that used for the Mk-48 APH (Acoustic Prediction Handbook) be developed for SUBRAP data. SVP/XBT data obtained either by submarine in-situ measurements or predicted for an area by FNWC would be encoded to access an on-board SUBRAP acoustic performance handbook. The content and format of acoustic data would also be contained in the SUBRAP APH.

Employing the suggested encoding technique will reduce the SUBRAP broadcast for an area from 42 teletype lines to a single line containing only 12 characters. This "short form SUBRAP" will allow 5 complete area forecasts to be passed on one line of teletype.

The SVP/XBT encoding technique minimizes communications requirements, maximizes the possible acoustic data content, and permits the option to supplement predicted data with in-situ measurements. This option should satisfy the inherent feeling of the submarine commander that in-situ measurements provide more useful information than can be obtained from predictions. With this method, in-situ knowledge can be quickly applied to determine the acoustic performance predictions. (The possibility that random in-situ SVP measurements are less accurate for range predictions than an SVP computed/predicted for the overall area has been considered, but lacking substantiation of this possibility, the above option is considered a reasonable approach for employing the proposed on-board SUBRAP APH.)

Evaluation of the validity of the proposed SUBRAP program is recommended as part of the COMSUBDEVGRU TWO Submarine Exercise Program. The SUBRAP APH might also be considered as an adjunct to or as a section of the SUBDEVGRU TWO Submarine Sonar Manual. As an alternative, microfiche storage and retrieval of the SUBRAP APH data is recommended.

1. INTRODUCTION

This report presents the results of a technical study (Task No. 3) in support of the Long Range Acoustic Propagation Project (LRAPP) acoustic prediction activities. The specific intent of Task No. 3 was to evaluate the utility of the LRAPP SUBmarine RAnge Prediction (SUBRAP) program. This study was conducted by Tetra Tech, Inc. under contract number N00014-71-C-0401.

A significant input to this study effort was the information provided by the staff of COMSUBDEVGRU TWO (Commodore Fagan had previously indicated concern over the utility of the SUBRAP program and had initiated a review of the program by his staff). This report contains several of the findings and recommendations of Commodore Fagan's staff, in particular, CDR Stoehr, LCDR Blockinger and Mr. Seaton provided substantial contributions to the results presented in this report.

2. CURRENT SUBRAP PROGRAM UTILITY

Information was obtained on SUBRAP utility in three submarine operating areas: the Atlantic (SUBLANT and COMASWFORLANT), the Pacific (SUBPAC), and the Mediterranean (Sixth Fleet/CTF 64/69). Information was derived from operating force instructions for the use of SUBRAP and from COMSUBDEVGRU TWO staff notes on contact made with the force commanders to evaluate SUBRAP utility. The following observations were made:

1. Atlantic (SUBLANT and COMASWFORLANT)
   a. The SUBRAP program is not used at the present time for submarines at sea for the following reasons:
      (1) The SUBRAP format is too long to fit on an already crowded submarine broadcast schedule. (SUBLANT indicated that at best one submarine could be provided SUBRAP, but even this would tend to overload the schedule.)
      (2) Submarine force has not requested SUBRAP information primarily because SUBRAP data have not been demonstrated to provide additional or more accurate data than can be gained by in-situ measurements by the submarine.
      (3) As a result of the above, the use of SUBRAP has not been promulgated by an operating instruction, is not given an in-depth coverage in the submarine school program, and is generally not well documented for the Atlantic submarine force.

b. SUBRAP data are used in the design of COMSUBDEVGRU TWO exercises. However, while SUBRAP data have been valuable as an aid in planning exercise configurations when the full computer output (propagation loss out to 110 nm) was used (the agreement between preexercise predictions and at-sea results was generally quite close), the basic SUBRAP broadcast format is limited to a propagation loss range of 45 nm; when these data were used instead of the computer printouts, substantial errors were introduced because of the 45-nm cutoff. A 45-nm range limitation may be adequate for the Mediterranean, but is inappropriate for Atlantic forecasts.

2. Pacific (SUBPAC)

a. Use of the SUBRAP program has been promulgated for the Pacific submarine force by COMSUBPACINST C1360.1A.

b. The SUBRAP data are used by the submarine force, but only for transiting events and are usually obtained prior to going-to-sea.

c. On-station submarines prefer, as in the Atlantic, to consider in-situ measurements instead of predictions for determining the acoustic conditions.

d. The SUBRAP format for the Pacific has a 50-nm range cutoff and as observed in the Atlantic, limits the useful range of the SUBRAP predictions.

3. Mediterranean (Sixth Fleet/CTF 64/69)

a. Use of the SUBRAP program has been promulgated for the Mediterranean submarine force by CTF-64/69 INSTR C3500.1A.

b. The SUBRAP data are used primarily by the SSBN force. SUBRAP is copied from the submarine broadcast and has the format shown in Figure 1. This

```
FM:     COMSUBFLOT EIGHT
TO:     ALL UNITS COPYING THIS BCST
BT
C O N F I D E N T I A L   (SAMPLE NOT CLASSIFIED)
1.      SNYOPTIC SITUATION  2ØØØØ1Z MON YR
FRNTL SYSTEM FM XTRM SOUTHERN PORTUGAL NORTHEAST THRU
SMALL 1ØØ6MB LOW NR 43N7 Ø1E1 LOOPING EAST THEN NORTHWEST
TO 98ØMB LOW OVR IRISH SLA.  BY END OF PRD 1ØØ6MB LOW WILL
FILL AND MOVE TO NORTHERN ITALY WITH FRNT SOUTHWEST INTO
NORTHEAST MOROCCO.  1Ø2ØMB HIGH PRESS RIDGE OVR MOROCCO/
ALGERIA WILL MOVE EAST MERGING WITH 1Ø2ØMB HIGH PRSNTLY
33.3N9 22E4.  WKNG FRONT THRU ERLY PRD.  HAZE ALG/AFRICAN
CST EAST OF 1ØE1.  SHWRS/TSTMS ALG FRONTL SYSTEM FCST TO
MOVE OVR WEST MED.  SHWRS/ISLTD TSTMS ERLY PRD OVER
SOUTHERN ITALY ADRIATIC AND WESTERN GREECE.
PTCHY CSTL FOG ERLY MORN CENTRL MED.
2.      SUBRAP 3ØHR FCST FOR 17ØØHZ FM ØØØØZ

  MMØ1 6Ø61Ø/16/SCTD SHWRS/3/Ø4 BCMG MID PRD 4Ø412/18/ISLTD
SHWRS/4/Ø5 ØØ64Ø 864Ø 1261Ø 2Ø6ØØ 3Ø595 4Ø59Ø 6Ø558 81558 12Ø555 W4
        GR 7.5 17ØØHZ 11-21

        80....Ø5...1Ø...15...2Ø...25...3Ø...35...4Ø...45.
          .   II
          . xxxxxxx
          .        xxx
        9Ø.           xxxxx
                           xxxxx
          .
          .
          .
       1ØØ.                     xx
          .                       xxxxxxxxx
          .                                xxxxxxxxxxx
          .
       11Ø.............................................x..

A.     3/ 16, 52/ 15, 42/ 15, Ø
B.     7Ø/ 16, 63/ 15, 52/ 15, Ø. Ø/ Ø, Ø/ Ø
C.     45  35/ 66, 91
D.     45, 41/ 72, 37/ 68, 33/ 64, 28/ 59
3.      PARAGRAPH 2 REPEATED FOR 85ØHZ.
```

Figure 1. Sample Mediterranean SUBRAP Broadcast

format is 51 teletype lines long and includes two propagation loss frequencies and a weather forecast.

The SSBN submarines evaluate the SUBRAP data as useful in selecting an operating mode for avoiding detection. The long format is not a problem to the SSBN and the submarine schedule for the Mediterranean does not have the volume handled by the Atlantic.

c. The SUBRAP broadcast is normally not copied by the non-SSBN submarines because of the length of the format. The non-SSBN submarines find the SUBRAP broadcast length, and the tendency to reject predictions in favor of in-situ measurements, major drawbacks in the use of SUBRAP.

4. Summary of Current SUBRAP Program Utility

The current SUBRAP program utility may be summarized as follows:

a. For on-station SSBNs, SUBRAP provides useful information when the broadcast schedule can bear the lengthy format.

b. For transiting SS/SSNs, predeployment SUBRAP predictions provide a useful estimate of expected detection ranges (also for exercise planning).

c. For on-station SS/SSNs the SUBRAP program requires a lengthy format to provide only gross information of little tactical value to the SS/SSN.

3. SUBRAP DEFICIENCIES

The observations reported in Section 2 indicate the following deficiencies in the current SUBRAP program:

1. SUBRAP format length places unacceptable communication time requirements on both the submarine broadcast schedule and on the time to copy for the submarine. (The submarine is normally required to leave optimum search depth in order to copy the broadcast.)
2. A 50-nm range limitation is not acceptable for complete Atlantic and Pacific predictions.
3. Documentation of basic SUBRAP program, interpretation of format, and potential applications of data are inconsistent among users and in some cases nonexistent.
4. SUBLANT has not sponsored use of SUBRAP for the Atlantic submarine force.
5. SUBRAP has not clearly demonstrated an advantage of the predictions over in-situ measurements by the submarine.
6. SUBRAP has no provision for providing tactically useful propagation loss versus depth profiles for the submarines.
7. SUBRAP has no provision for supplementing predicted data with in-situ measurements (assuming the predictions have no advantage over measured data).

4. ACOUSTIC PERFORMANCE HANDBOOK

The fundamental factor driving acoustic range prediction data for a given area is the thermal structure of the medium and the associated sound velocity profile (SVP). Specification of the SVP for a given area defines the raypath patterns and the expected propagation loss for a given frequency. Given the propagation loss profiles for an area, it is a relatively simple task to complete the terms of the sonar equation and compute the 50 percent probability of detection range for a given target and receiver.

The essential data element needed by the submarine force is the propagation loss structure for the operating area. Since the propagation loss is essentially defined by the area SVP, the key factor becomes the shape of the SVP. If the SVP structure could be coded to access an on-board file of resultant propagation loss contours, then the data requirements of the submarine could be reduced to only the predicted SVP code.

The above concept was discussed with the COMSUBDEVGRU TWO staff and the discussions led to the Mk-48 weapon system Acoustic Performance Handbook. The APH was developed by the Ordnance Research Laboratory to satisfy the weapon system requirement for detailed acoustic data inputs. The acoustic data have to be provided in real-time from in-situ measurements by the submarine. The weapon system acoustic data inputs are precomputed for a given SVP structure and cataloged in the APH according to an SVP identifier code. The SVP identification code is developed using the Heuristic Aid to Matching Profiles (HAMP) technique.

The HAMP indexing technique operates as follows:

1. The measured SVP or XBT trace is approximated by straight-line sections. A maximum of five sections is allowed.

2. The straight-line profile is then compared to a full-scale transparency (one for SVPs and one for XBTs) and the HAMP Index read off.
3. The HAMP Index then specifies an equivalent profile number and the tables in the APH containing the required acoustic input data.

Figure 2 illustrates the HAMP transparency for SVP (BQH-1) profiles. A detailed discussion on the use of the HAMP is included in the "Preliminary Acoustic Performance Handbook for Torpedo Mk-48 Mod 1," March 1972 published by ORL. Figure 3 illustrates the application of the HAMP to the SVP taken by USS SKATE on 11 July 1969. (This SVP was taken from SUBDEVGRU TWO files as a random choice.) The HAMP Index for the three sections is 311, and according to procedures outlined in the APH, the full index is 31133. HAMP index 31133 refers the observer to Equivalent Profile T5 and Tables 4-15 and 4-15a. Tables 4-15 and 4-15a are reproduced in Figures 4 and 5. These tables provide the necessary input data for the Mk-48 weapon system.

The above procedure is simple to perform and according to recent at-sea evaluations provides an accurate representation of acoustic conditions for the Mk-48 sonar. (Tests conducted by NUSC Newport are believed to show propagation loss by HAMP technique within 1 dB of loss computed by NUSC.)

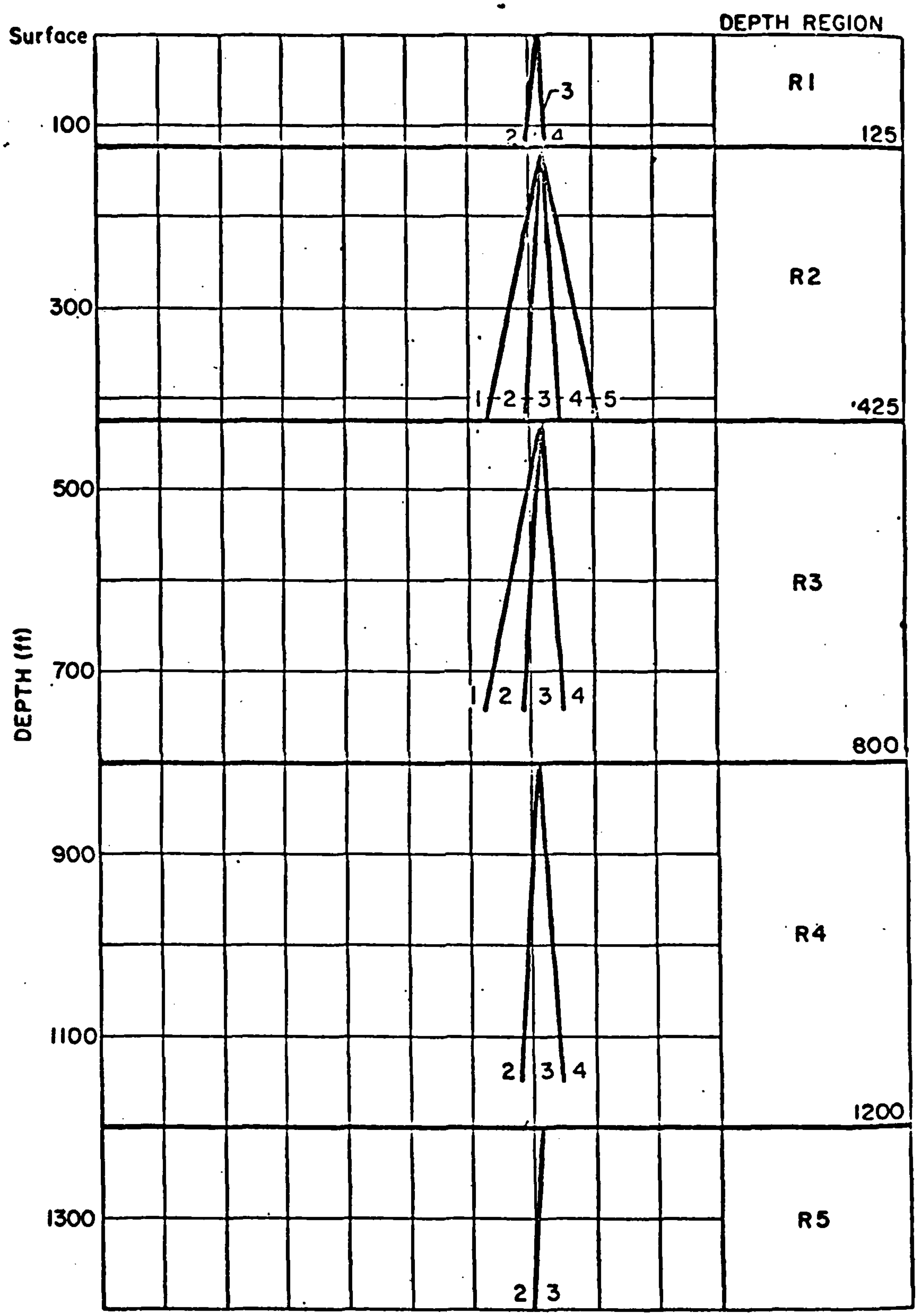


Figure 2. SVP (BQH-1) HAMP Transparency

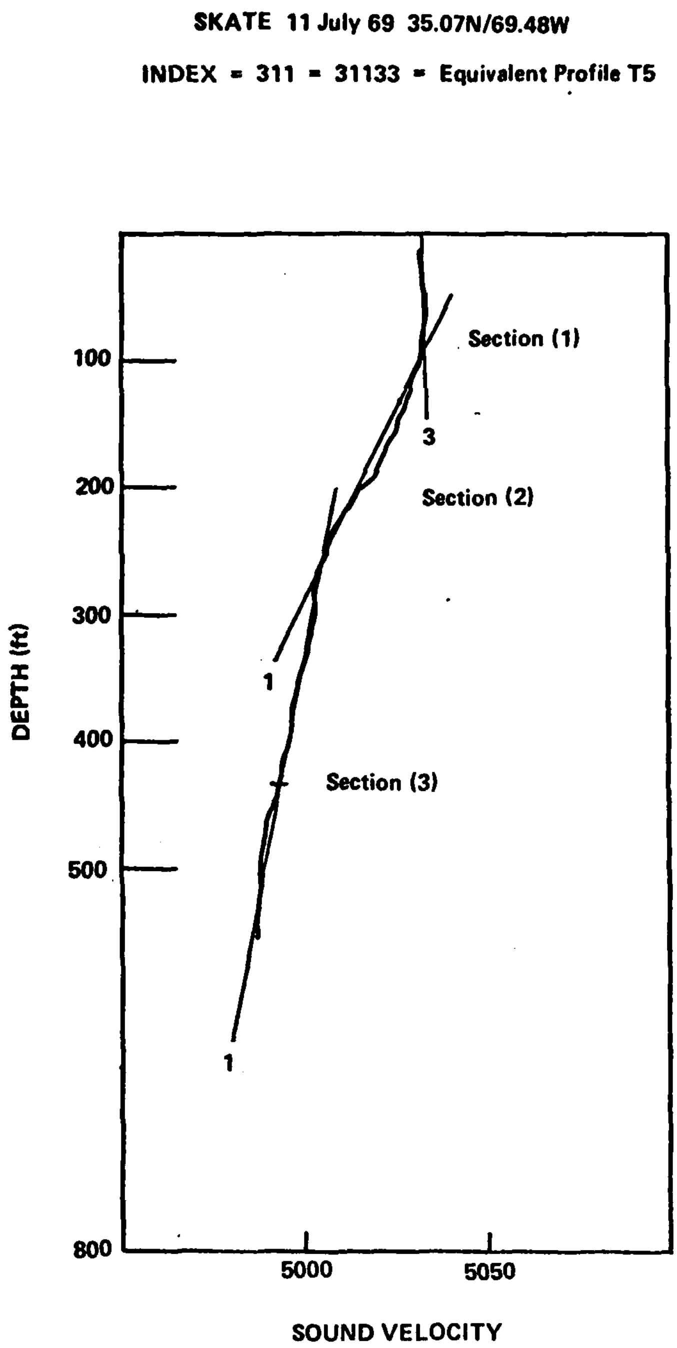
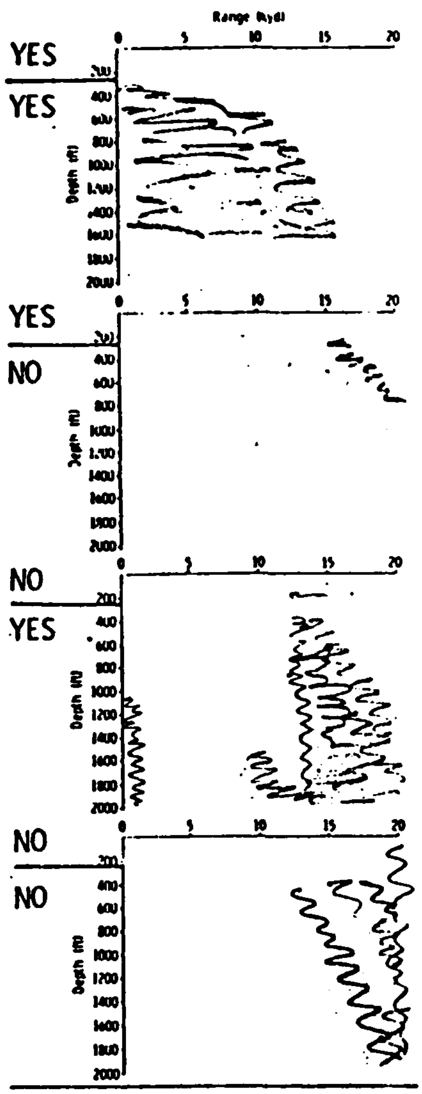


Figure 3. HAMP Applied to Actual SVP

TABLE 4-15. SETTING DATA
Use with Profile 15

TARGET LOCATION ESTIMATION

HEARD IN ZONE (FT)		TARGET DEPTH (FT)	TARGET RANGE (KYD)
0-250	250-950		
YES	YES	UNK	0-14
YES	NO	<250	10-20
NO	YES	>250	10-20
NO	NO	>250	12-20



ACTIVE MODE - SHALLOW WATER (<700 FT)

TARGET DEPTH (FT)	SOFT BOTTOM															
	SEA STATE <3								SEA STATE ≥3							
	LOW SEARCH SPEED				MEDIUM SEARCH SPEED				LOW SEARCH SPEED				MEDIUM SEARCH SPEED			
	SD	PA	LD	FM	SD	PA	LD	FM	SD	PA	LD	FM	SD	PA	LD	FM

DATA DELETED FOR CLASSIFICATION PURPOSES

ACTIVE MODE - SHALLOW WATER (<700 FT)

TARGET DEPTH (FT)	HARD BOTTOM															
	SEA STATE <3								SEA STATE ≥3							
	LOW SEARCH SPEED				MEDIUM SEARCH SPEED				LOW SEARCH SPEED				MEDIUM SEARCH SPEED			
	SD	PA	LD	FM	SD	PA	LD	FM	SD	PA	LD	FM	SD	PA	LD	FM

DATA DELETED FOR CLASSIFICATION PURPOSES

NOTE - FOR SHALLOW WATER:

1. If LOW SEARCH SPEED FM is less than 3, use ONE-HALF PING INTERVAL
2. If MEDIUM SEARCH SPEED FM is less than 2, use ONE-HALF PING INTERVAL

Figure 4. Example of Table 4-15

TABLE 4-15A. SETTING DATA
USE WITH PROFILE T5

ACTIVE MODE - DEEP WATER (>700 FT)

TARGET DEPTH (FT)	SEA STATE <3								SEA STATE ≥3							
	LOW SEARCH SPEED				MEDIUM SEARCH SPEED				LOW SEARCH SPEED				MEDIUM SEARCH SPEED			
	SD	PA	LD	FM	SD	PA	LD	FM	SD	PA	LD	FM	SD	PA	LD	FM

DATA DELETED FOR CLASSIFICATION PURPOSES

PASSIVE MODE - ALL BOTTOM DEPTHS

TARGET DEPTH (FT)	HIGH TARGET SPEED								LOW TARGET SPEED							
	LOW SEARCH SPEED				MEDIUM SEARCH SPEED				LOW SEARCH SPEED				MEDIUM SEARCH SPEED			
	SD	PA	LD	FM	SD	PA	LD	FM	SD	PA	LD	FM	SD	PA	LD	FM

DATA DELETED FOR CLASSIFICATION PURPOSES

Figure 5. Example of Table 4-15A

5. APH APPLICATION IN SUBRAP

The recent success of the APH technique for the Mk-48 weapon system encourages the proposal that an APH-like technique be developed for SUBRAP. (It is recognized that the Mk-48 has a high frequency sonar and is therefore more accurately defined by only the SVP; however, given an ASRAP/SHARPS area, the SVP is still the primary variable in determining propagation loss for the lower frequencies.)

5.1 Factors Requiring Study

In order to ascertain the applicability of an APH technique for SUBRAP the following factors require further study:

1. Design of a HAMP Index transparency that responds to mixed layer depth.
2. Development of a HAMP Index that considers geographic area (water depth and bottom type).
3. Analysis of the propagation loss errors introduced by variance allowed in assigning gradient spread for a given gradient index number.
4. Analysis of errors introduced when using single measurement (in-situ) SVP vice average area SVP.

5.2 Proposed System

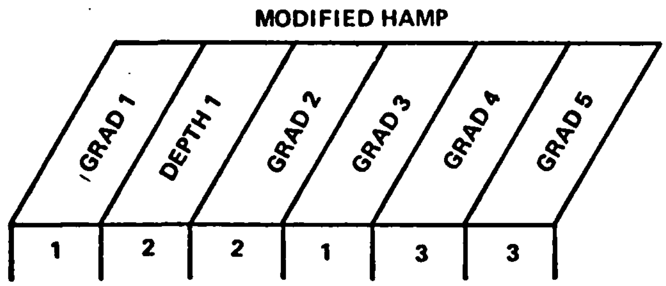
The concept proposed would be similar to that now used for the Mk-48 APH. This approach has the advantage that submarine personnel will be familiar with the procedures required to operate the system, and training in addition to that required to operate the Mk-48 APH will not be required.

Depending on the outcome of the study factors (1 and 2 in Subsection 5.1), the HAMP Index would be modified from its present format. It is conceivable that the HAMP Index may be a six-digit number as shown in Figure 6. The modification represents an index digit for mixed layer depth, coded as indicated, and five gradient indices, one in-layer and four below.

Depending on the outcome of the study factors (3 and 4 in Subsection 5.1), an acceptance test would be provided for each acoustic data set. Several HAMP indicies may refer to the same equivalent profile and acoustic data set. Prior to using the data set, the measured profile must be observed to lie within the boundaries established for approximating the profile. Figure 7 illustrates the equivalent profile test transparency for profile T8.

With respect to the Acoustic Performance Handbook data format, the information of most importance to the submarine commander is the propagation loss structure-propagation loss as a function of range and receiver depth. In keeping with standard SUBRAP procedure, this information would be provided for both a source within the layer (60 ft) and 200 ft below the layer. These data are illustrated in Figure 8 for two frequencies. In addition, conversion factors for computing loss at other frequencies having the same raypath pattern are given along with a summary of depth/detection data for the different frequencies. When frequency conversion factors are not feasible, additional propagation loss contours will be provided.

Using the propagation loss contours, a submarine commander can add the remaining sonar equation terms (self or ambient noise, RD, etc.) and design a tactical search or avoidance plan to optimize his sonar advantage for an expected target source level. It would now be possible to design an indepth search plan that considers in detail, the above and below layer conditions in determining the percent of time spent searching above or below layer.



Sample HAMP Index = 122133

DEPTH	CODE
0	No Layer
1	50' Layer
2	100' Layer
3	150' Layer
4	200' Layer
5	250' Layer
6	300' Layer
7	400' Layer
8	600' Layer

Figure 6. Modified HAMP Index

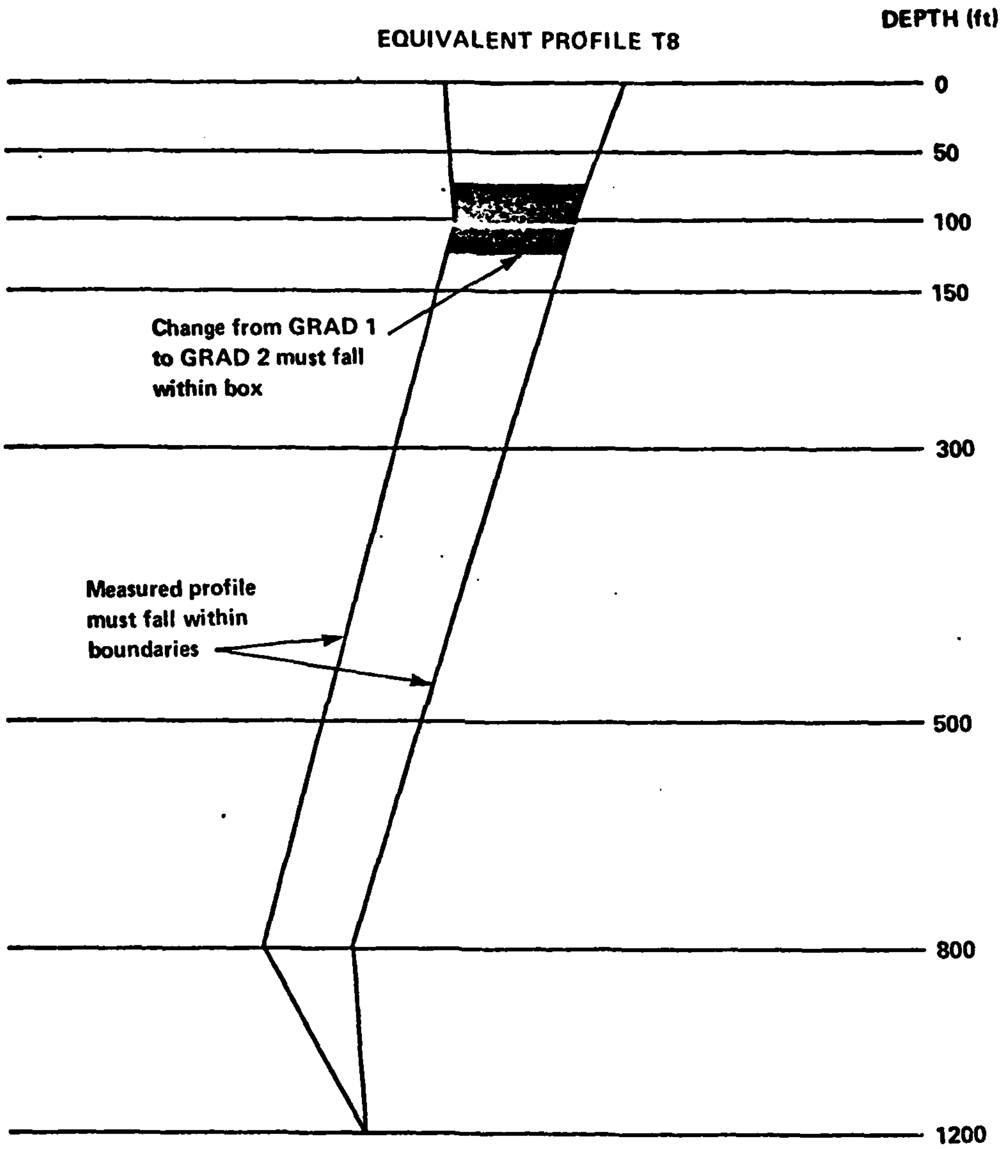
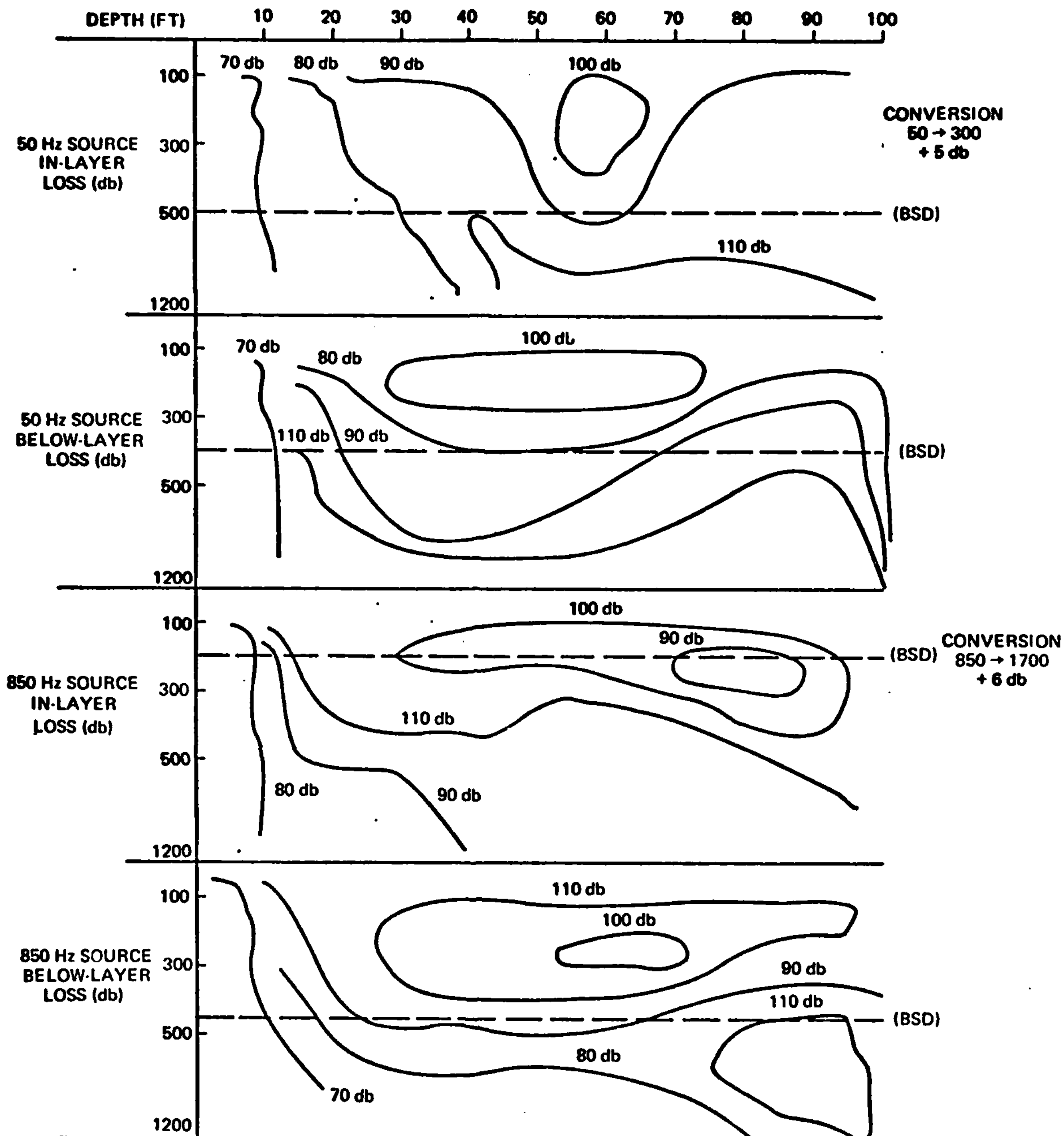


Figure 7. Profile Acceptance Test

TABLE 21. PASSIVE SEARCH DATA

USE WITH PROFILE T8.

RANGE (nm) LAYER DEPTH 100 FT



FREQ	50 Hz	300 Hz	850 Hz	1700 Hz	COMPOSITE
BEST SEARCH DEPTH (BSD)	500 FT	500 FT	325 FT	350 FT	400 FT
BEST AVOIDANCE DEPTH	1000 FT	1000 FT	100 FT	125 FT	100 FT

TARGET DEPTH UNKNOWN

Figure 8. Sample APH Data Format (Table 21)

In addition to passive acoustic data, the submarine needs to know the active sonar search conditions. Two factors are of importance here: propagation loss and reverberation level. As with the passive data, the submarine commander can provide the additional sonar factors and compute the expected detection ranges. The proposed active sonar data format is illustrated in Figure 9. Depth dependence in the loss and reverberation level contours is again the essential element in providing useful data to the submarine.

The APH may also include sonar operating factors/sonar settings that would be optimum for the acoustic conditions. These data would be added, based on operating experience with the APH, by the submarine force (i.e., COMSUBDEVGRU TWO). The data would be similar to that provided by the Submarine Sonar Manual and would facilitate using the APH data in designing sonar search plans.

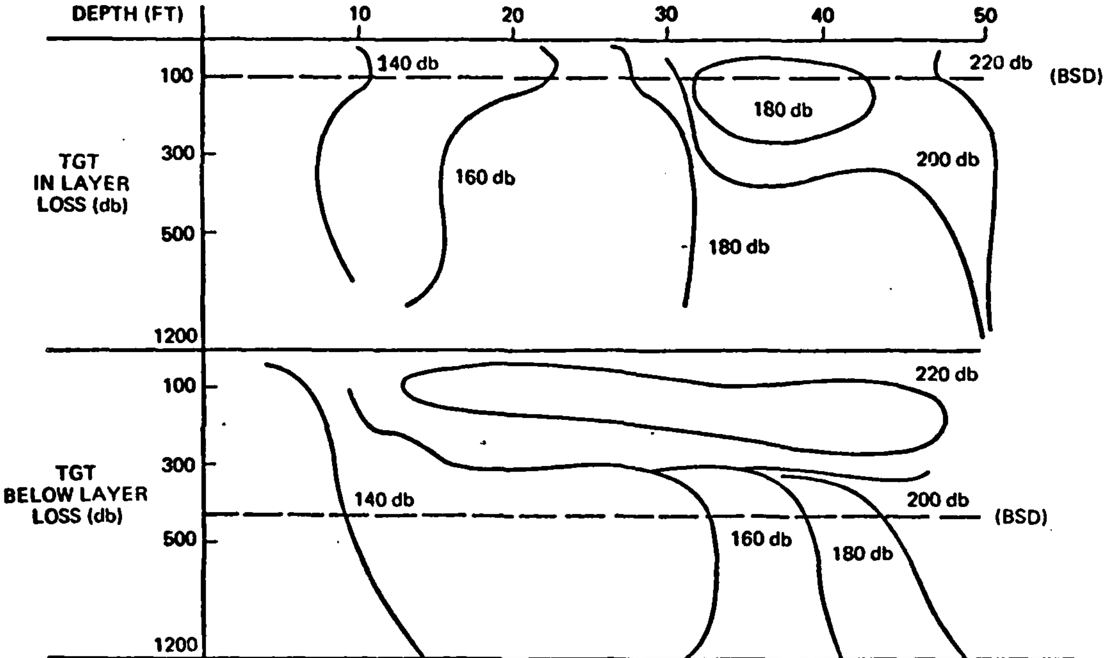
A final item for inclusion in the APH tables would be the expected counter-detection ranges for a given threat sonar (sonar type). The format is illustrated in Figure 10.

The proposed SUBRAP APH provides the opportunity to substantially reduce the SUBRAP broadcast length. Information essential to a SUBRAP forecast can be limited to SUBRAP Area Identifier, Wind Wave Height, and HAMP Index as shown in Figure 11. A complete SUBRAP forecast can be specified in 12 characters. Using this format, five complete SUBRAP forecasts can be transmitted in one line of teletype. This is of particular value to a submarine transiting several SUBRAP areas in a relatively short transit time. The format also permits large ocean areas to be forecast in less lines than now required for a single SUBRAP (i.e., 105 complete area forecasts could be sent in the space now required for a single-frequency one-area SUBRAP).

TABLE 21A ACTIVE SEARCH DATA

USE WITH PROFILE T8

RANGE (NM) LAYER DEPTH 100 FT



	TGT SURF OR IN-LAYER	TGT BELOW LAYER	TGT DPH UNK
BEST SEARCH DEPTH	100'	400'	400'
BEST AVOIDANCE DEPTH	150'	300'	300'

RANGE (NM)

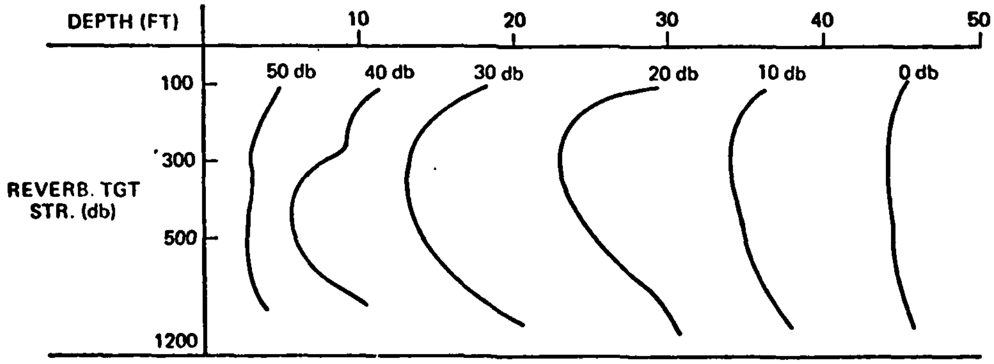


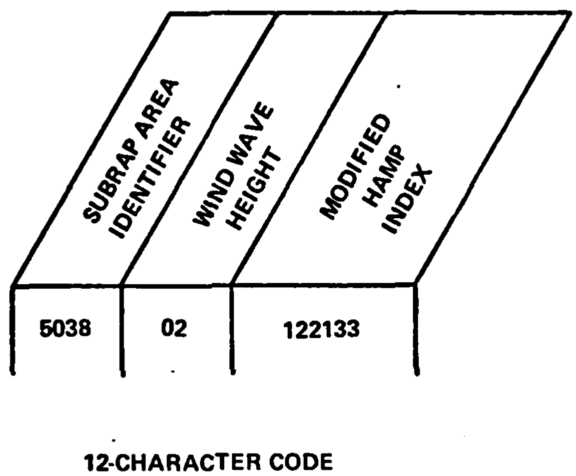
Figure 9. Sample APH Data Format (Table 21A)

TABLE 21B - EXPECTED COUNTERDETECTION RANGE USE WITH PROFILE T8

Own Ship	Counterdetection Range (nm)				
	Sonar A	Sonar B	Sonar C	Sonar D	Sonar E
Slow Speed (45 dB)					
In-Layer	10/15	15/10	20/15	10/5	5/2
Best Depth	5/5	5/5	4/4	3/3	1/1
Avoid Depth	1/1	2/1	1/1	2/2	1/1
Hi-Speed (60 dB)					
In-Layer	20/15	30/15	40/20	30/10	20/10
Best Depth	10/7	10/5	15/5	10/5	5/2
Avoid Depth	5/5	5/2	10/10	5/2	5/2

Note: Opposition In-Layer/Opposition Below-Layer

Figure 10. Sample APH Data Format



Line Format = 5038/02/122133/ = 15 Characters

Teletype Line = SUBRAP 1/SUBRAP 2/SUBRAP 3/SUBRAP 4/SUBRAP 5

(5 Areas = 75 Characters)

Figure 11. SUBRAP Broadcast

The proposed method will result in the requirement to carry on-board the submarine extensive APH tables. The amount of data, to date, for the Mk-48 APH fills a normal 1" loose-leaf divider and covers all of the North Atlantic. The amount of SUBRAP APH data is expected to greatly exceed the Mk-48 APH data because of the addition of SUBRAP areas as part of the data breakdown. To minimize the amount of data carried on-board, a SUBRAP APH would be developed for each of four seasons and for each major ocean area (i.e., Med, WLANT, ELANT, WPAC, etc.).

An alternative method for handling the APH data is by microfiche. Submarines will have the capability to handle microfiche data, and depending on the amount of APH data required, the submarine may be able to carry a complete SUBRAP file.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

The following is concluded, prior to the evaluation of the proposed technique, and therefore represents what can be accomplished if the proposed SUBRAP APH technique is implemented:

- SUBRAP data, indexed to an equivalent SVP and coded by a HAMP technique, minimize communications requirements, maximize the amount of sonar data available, and permit the option to supplement predicted data with in-situ measurements.
- On-board access of the APH alleviates the objections of the submarine commander that since the measurements are in-situ, he has more accurate knowledge of the environment than can be predicted. His knowledge of the environment can be converted directly into useful tactical acoustic data using the HAMP and SUBRAP APH.
- Until additional information is developed on the accuracy of single random SVP data vice area average SVP data, the use of a single submarine SVP measurement for accessing the APH data is considered a valuable aid to the on-station submarine commander.
- The APH concept provides the submarine commander with the one piece of information that has not been available in real-time up until this time. This information, propagation loss as a function of range and depth, is of significant tactical importance to the submarine.
- When the submarine is unable to copy the broadcast, he can still maintain updated SUBRAP data by taking SVP measurement.

- Proposed SUBRAP broadcast format provides the opportunity to send SUBRAP predictions to all submarines without overloading the broadcast schedule. Submarine copy time would no longer be a limitation/drawback of SUBRAP.
- The proposed system could be easily adapted to SHARPS and ASRAP to reduce broadcast time and increase data content for these systems.

6.2 Recommendations

Many of the difficulties experienced to date with the SUBRAP program are a result of attempts to merge airborne and surface-ship predictions into a format for subsurface use. There is a fundamental weakness in attempting to do this: surface and airborne platforms have essentially unlimited E/M reception capability and minimal knowledge of the acoustic structure of the subsurface environment -- submarines have a current extensive knowledge of the environment surrounding them and minimal contact with the E/M environment. The current SHARPS/ASRAP derived SUBRAP program leans too heavily on the use of the E/M environment to provide a useful product for the submarine force (with the exception of some SSBNs). A new approach such as proposed in this report is recommended.

To proceed with the evaluation and possible implementation of the proposed SUBRAP APH technique the following items are recommended:

- Conduct the analyses discussed in Subsection 5.1 to develop a HAMP for SUBRAP.

- Construct a preliminary SUBRAP APH for use with the SUBRAP HAMP.
- Evaluate the proposed SUBRAP APH program as part of the COMSUBDEVGRU TWO Exercise Program.
- Request COMSUBDEVGRU TWO provide a Tactical Development Memorandum (TDM) for the submarine tactical use of the propagation loss data.
- Provide documentation of SUBRAP APH method equivalent in content to Submarine Sonar Manual. Consider incorporating SUBRAP APH in Submarine Sonar Manual.
- Investigate use of microfiche storage and retrieval for APH data.
- When development is complete, request SUBLANT promulgate an instruction for use of SUBRAP. Incorporate SUBRAP APH in other submarine force instructions.